APPARATUS AND METHOD TO REDUCE INTERFERENCE BETWEEN DISPARATE COMMUNICATION SYSTEMS

CROSS REFERENCE TO RELATED APPLICATIONS

[0001] This application claims priority to U.S. provisional patent application Ser. No. 61/474,019, filed on Apr. 11, 2011, which is incorporated herein by reference in its entirety. This application is also related to U.S. provisional patent application Ser. No. 61/367,761, filed on Jul. 26, 2010, which is incorporated herein by reference in its entirety.

FIELD

[0002] Embodiments of the present invention are directed, in general, to communication systems and, in particular, to an apparatus, method and system configured to reduce interference for user equipment operable in disparate communication systems.

BACKGROUND

[0003] Long term evolution ("LTE") of the Third Generation Partnership Project ("3GPP"), also referred to as 3GPP LTE, refers to research and development involving the 3GPP LTE Release 8 and beyond as part of an ongoing effort across the industry aimed at identifying technologies and capabilities that can improve systems such as the universal mobile telecommunication system ("UMTS"). The notation "LTE-A" is generally used in the industry to refer to further advancements in LTE. The goals of this broadly based project include improving communication efficiency, lowering costs, improving services, making use of new spectrum opportunities, and achieving better integration with other open standards.

[0004] The evolved universal terrestrial radio access network ("E-UTRAN") in 3GPP includes base stations providing user plane (including packet data convergence protocol/radio link control/media access control/physical ("PDCP/RLC/MAC/PHY") sublayers) and control plane (including radio resource control ("RRC") sublayer) protocol terminations towards wireless communication devices such as cellular telephones. A wireless communication device or terminal is generally known as user equipment (also referred to as "UE"). A base station is an entity of a communication system or network often referred to as a Node B or an NB. Particularly in the E-UTRAN, an "evolved" base station is referred to as an eNodeB or an eNB. For details about the overall architecture of the E-UTRAN, see 3GPP Technical Specification ("TS") 36.300 v8.7.0 (2008-12), which is incorporated herein by reference. For details of the radio resource control management, see 3GPP TS 25.331 v.9.1.0 (2009-12) and 3GPP TS 36.331 v.9.1.0 (2009-12), which are incorporated herein by reference.

[0005] As wireless communication systems such as cellular telephone, satellite, and microwave communication systems become widely deployed and continue to attract a growing number of users, there is a need to accommodate a large and variable number of communication devices that transmit an increasing quantity of data within a fixed spectral allocation and limited transmit power. The increased quantity of data is a consequence of wireless communication devices transmitting video information and surfing the Internet, as well as performing ordinary voice communication. The aforementioned services are provided while accommodating substantially simultaneous operation of a large number of wireless communication devices.

[0006] A further continuing development is the introduction of communication systems such as wireless local area networks ("WLANs") (e.g., WiMAX communication systems) that provide alternative communication services for mobile and fixed-point equipment, and that use frequency bands or channels adjacent to those used by traditional cellular communication systems or networks such as 3GPP LTE communication systems (also referred to as LTE communication systems). Coexistence between the cellular communication systems and the WLAN communication systems sometimes introduces problematic interference therebetween. The interference has been observed between the LTE communication system and the industrial, scientific and medical ("ISM") radio bands used by the WLAN communication systems, especially for communication by a device such as user equipment operable in both communication systems or networks, and also by devices operable on global positioning system ("GPS") radio bands, also referred to as global navigation satellite system ("GNSS") bands.

[0007] The 3GPP LTE and ISM technologies working on adjacent frequencies have been observed to exhibit several interference types. One interference type is an ISM device blocking an LTE user equipment, and vice versa. Another interference type is spurious emission from an ISM device producing a level of interference to LTE user equipment, and vice versa. It is generally recognized that a filter for a transceiver of the device or user equipment cannot provide sufficient rejection on an adjacent frequency to eliminate interference between two adjacent communication systems. Accordingly, a generic radio frequency ("RF") front-end design is not expected to resolve this interference problem.

[0008] One of the more problematic issues is how to manage the coexistence of two disparate communication systems such as a cellular communication system (e.g., a LTE communication system) and a WLAN communication system. In view of the growing deployment of communication systems such as cellular communication systems as well as WLAN communication systems operating within the same physical area and the introduction of user equipment that is operable with both communication systems, it would be beneficial to coordinate the communications to reduce or avoid interference between the disparate communication systems. In addition, accurate reporting of interference by user equipment can enable improved coordination or allocation of communication resources to reduce or avoid interference between the disparate communication systems.

SUMMARY

[0009] One embodiment includes a method for reducing interference. The method includes determining, by a user equipment, active and inactive subframes of a plurality of subframes associated with a wireless local area network (WLAN) communication. The method then includes performing relative signal quality measurements on the inactive subframes, and providing, to a base station, a relative signal quality measurement report based on the relative signal quality measurements performed on the inactive subframes.

[0010] Another embodiment is directed to an apparatus. The apparatus includes at least one processor and at least one memory including computer program code. The at least one memory and the computer program code are configured, with